

Simple Machines – Inclined Plane, Lever

4th or 5th Grade

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Benchmarks:

(4th) SLC 10: Students will identify and explain how simple machines help mechanical devices operate (e.g., bicycles, pencil sharpener, fishing rod, etc.) by describing the work a machine can do (e.g., change the size of the force, change the direction of force, and/or change the distance a force moves something).

(5th) SLC 6: Students will identify the differences between work and force as they relate to each of the 6 simple machines.

Objectives:

To teach students why simple machines are used, 2 different simple machines that can be made with a board, and how to use simple machines.

Materials:

- 2 crates
- Books
- 2 long wood boards
- 2 wood triangle prisms
- Paint stirrers
- Bolts
- Markers

Initial Demonstration:

Have a crate (or 2) filled with books or heavy objects. Let each student take turns to try to lift it up and set it on the desk. Ask them about how it felt. Was it easy, hard, heavy, light...? What else could they do to make their job (lifting the heavy crate onto the desk) easier? Are these ideas practical?

Target Observations:

- It is hard to lift the crate up onto the table because it is heavy
- To make lifting the crate easier we could use a crane, forklift, car jack
- Using a crane, forklift, or a car jack would not be practical in the classroom (too large/too expensive/we don't have the materials)
- (?) We could use an incline plane or a lever to make lifting the crate easier

Target Model:

-To make lifting an object easier we can use (simple) machines.

Procedure:

If the students come up with ideas of using an inclined plane or lever, introduce the materials (board, fulcrum etc.) and ask a student to show how to use it. If they do not come up with any simple machines, introduce the materials for one simple machine, break the class in half, and let them figure out how to use it to lift the crate. Use the following engagements for each simple machine to get the students thinking about how they can use the materials. Once students understand the uses of one machine, go onto the other.

Incline Plane: Give the students a long board and have them come up with different ways to get the crate up the board. What do you have to do to get the crate up the board? What are these pushes and pulls called? Is it easier when using the board? If you have several different lengths of boards you can investigate how the angle (steep or flat) affects the ease of getting the crate up the board. At the end of the discussion have the students draw the inclined plane, label it, and list advantages and disadvantages.

Lever: How else could you use the board to lift something? Give the students a triangular prism of wood to use as a fulcrum. What do you have to do to one end of the board to lift the crate on the other end? How does the location of the fulcrum change how easy it is to lift the crate up and how high the crate goes? Have the students draw the set-up, label and list positives and negatives of using a lever.

Target Observations:

Incline Plane:

- You can get the crate up the board by pushing it up or pulling it up with a rope
- You need to use a force, a push or a pull, to get the crate up the board
- The force needed with the board feels less than the force needed to lift the crate up
- The flatter the incline is, the easier it is to move the crate up it
- Some advantages of the incline plane are that it is easier than lifting, you could move more weight with it, and that you need less people to move a heavy object with it
- Some disadvantages of the incline plane are that you need more equipment to use an incline plane and you need a lot of space to put the incline plane

Lever:

- If you put the board on the wooden triangle (fulcrum) it turns into a seesaw
- If you put the crate on one end of the seesaw and push down on the other, the crate will go up.
- If you move the fulcrum towards the crate, it is easier to lift but it does not go as high
- If you move the fulcrum away from the crate, it is harder to lift but it goes higher
- Some advantages of the lever are that it is easier than lifting, you don't have to push down – you can just stand on one end, and you can adjust how high you want it to go
- Some disadvantages of the lever are that the crate does not go very high when you make it easier to lift, it takes up a lot of space, and it is not very stable

Target Model:

-To make lifting an object easier we can use (simple) machines.

-Some simple machines take up a lot of space – the more space they take up, usually, the more they help lift things.

Demonstration:

Pass out paint stirrers to each student. On one side have them write “inclined plane.” Review that the incline plane has an angle sloping up to your desired location – this is what this side will be used for. On the clean flip side, have them label it “lever”, with “force” and “load” at the ends and “fulcrum” somewhere in the middle. Pass out bolts for a load and have the students use the “incline plane” side of their paint stirrers to lift the bolt up to the top of a book

or box. Pass out markers and have students use the “lever” side of the paint stirrer to lift the bolt up, placing the bolt on “load,” the marker under “fulcrum” and using their finger to push down at “force.” They can take these with them.

How would you use these simple machines, or larger, more practical, ones, in your everyday life? How would they make things easier for you? What are some examples of simple machines that you already use?

Target Observations:

- The incline plane could be used to get things from the high shelves, move heavy boxes of cereal, put boxes of old toys away, etc...
- The lever could be used as a seesaw on the playground, as an elevator to get up to my room, to help me make slam dunks, etc...
- Examples of incline planes already being used are stairs and ramps
- Examples of levers already being used are seesaws, doors, shovels and spoons

Target Model:

-To make lifting an object easier we can use (simple) machines.

-Some simple machines take up a lot of space – the more space they take up, usually, the more they help lift things.

-Simple machines can be used to help us do things everyday.